

# Stormwater Action Monitoring - Effectiveness Studies

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## Progress Report #2

### Evaluation of Hydraulic Control Approaches for Bioretention Systems

#### Prepared For:

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# Project Status Summary

## General Information

Contract / Grant Agreement IAA No. C2000041

Number:

Project Title: **Evaluation of Hydraulic Control Approaches for Bioretention Systems**

Organization: Washington State University

Project Managers: Anand Jayakaran, Washington State University  
Myles Gray, Geosyntec Consultants

Reporting Period: March 1, 2021 to April 30, 2021

## Brief description of Tasks and Achievements for current report period.

### Task 1: Project Planning and QAPP Development

Percent Complete, Project Phase 1:	100%
Percent Complete, Full Project:	100%
All deliverables to be completed:	Deliverables 1.1 to 1.3
Deliverables completed in <b>previous</b> reporting periods:	Deliverables 1.1 to 1.3
Deliverables completed in <b>this</b> reporting period:	None
Description of Achievements:	Deliverable 1.1: Meeting notes from TAC Kickoff Call Deliverable 1.2: Draft QAPP Deliverable 1.3: Final QAPP
Challenges faced during <b>this</b> monitoring period:	None to report

### Task 2: Installation and Startup

Percent Complete, Project Phase 1:	100%
Percent Complete, Full Project:	100%
All deliverables to be completed:	Deliverables 2.1 to 2.3
Deliverables completed in <b>previous</b> reporting periods:	Deliverables 2.1 to 2.3
Deliverables completed in <b>this</b> reporting period:	None
Description of Achievements:	Deliverable 2.1: Tables of equipment purchases Deliverable 2.2: Installation photolog Deliverable 2.3: Installation and Startup Report
Challenges faced during <b>this</b> monitoring period:	None to report

**Task 3: Monitoring and Study Implementation**

Percent Complete, Project Phase 1:	66%
Percent Complete, Full Project:	33%
All deliverables to be completed:	Deliverables 3.1 to 3.3 during Phase 1
Deliverables completed in <b>previous</b> reporting periods:	Deliverable 3.1
Deliverables completed in <b>this</b> reporting period:	Deliverable 3.2
Description of Achievements:	Deliverable 3.1: Progress Report #1 Deliverable 3.2: Progress Report #2
Challenges faced during <b>this</b> monitoring period:	Modified pollutant dosing and cistern mixing were implemented to improve influent pollutant concentration consistency. One autosampler temporarily shut down during water quality event #2.

**Task 4: Modeling Study**

Percent Complete, Project Phase 1:	NA: No effort planned in Phase 1
Percent Complete, Full Project:	0%
All deliverables to be completed:	None during Phase 1
Deliverables completed in <b>previous</b> reporting periods:	None
Deliverables completed in <b>this</b> reporting period:	None
Description of Achievements:	None to report
Challenges faced during <b>this</b> monitoring period:	None

**Task 5: Reporting and Communication of Findings**

Percent Complete, Project Phase 1:	0%
Percent Complete, Full Project:	0%
All deliverables to be completed:	Deliverable 5.1 during Phase 1
Deliverables completed in <b>previous</b> reporting periods:	None
Deliverables completed in <b>this</b> reporting period:	None
Description of Achievements:	None to report
Challenges faced during <b>this</b> monitoring period:	None

# 1 Introduction

This progress report documents the second monitoring period of the Stormwater Action Monitoring (SAM) Effectiveness Studies project Evaluation of Hydraulic Control Approaches for Bioretention Systems (Project). Progress Report #2 covers monitoring activities completed between March 1, 2021 and April 30, 2021. This period will be referred to as Monitoring Period #2. All monitoring activities were completed according to the Quality Assurance Project Plan (QAPP) dated August 20, 2020, with some noted modifications.

This report with appendices fulfills deliverable 3.2 of the Interagency Agreement effective September 9, 2019.

## 2 Continuous Monitoring Data

Continuous monitoring data were collected throughout Monitoring Period #2. Table 1 presents a summary of continuous monitoring data and data gaps. These data will be presented in more detail and analyzed as part of the Interim Presentation and the Final Report.

**Table 1. Continuous data collected during the monitoring period**

Data Stream	Logging Interval	Data Gaps
Precipitation	5-minute	None
Cistern Water Level	5-minute	None
Mesocosm Inlet Flow	5-minute	6/3-6/11/21- Catch basin closed 4/21-6/15/21- MS 42 valve closed
Mesocosm Outlet Flow	5-minute	3/29/21- Noticed biofilm clog in 41& 45 4/15/21- Biofilm clog in MS 41 OC orifice
Ponding Depth	5-minute	6/27-8/30/21-Faulty CTD10 sensor MS 45
Soil Moisture <sup>1</sup>	5-minute	None

<sup>1</sup> Soil moisture data are only collected for the six fully instrumented mesocosms

## 3 Water Quality Event #2

### 3.1 Sampling Overview

Water quality event #2 was completed on April 21, 2021. During this event, dosed stormwater runoff was routed to the six fully instrumented mesocosms and to the influent monitoring point. During water quality event #1, monitoring data indicated that influent pollutant concentrations were substantially lower than the high pollutant dosing targets from the QAPP for TSS, total copper, and total zinc. Following water quality event #1, the research team agreed that precise pollutant concentration targets would be difficult to achieve due to variability in stormwater quality from the facility catchment and due to variable settling of pollutants in the two cisterns. To limit influent water quality variability from storm to storm, the research team agreed to use the same dosing approach for all future storms while also modifying the mixing approach in the

cistern to limit particulate settling. Accordingly, cistern dosing was conducted using the same dosing that was used during water quality event #1.

Based on observations during water quality event #1, modifications were made during water quality event #2 to limit settling of Sil-co-Sil 106. Specifically, an additional mixing pump was added to the bottom of the cistern and ran continuously throughout the duration of the event. This approach reduced Sil-co-Sil 106 settling and will be used in all future water quality events.

Water was routed to the mesocosms and inlet point for eight hours to represent a moderate intensity storm as presented in Table 9 of the QAPP. Flow-weighted composite samples were collected for the duration of the eight-hour event and then overnight until the following morning. Each sample aliquot was 350 mL and was pumped into 20 L glass composite sampling containers. Following the completion of sampling, on the morning of April 22, 2021 the composite samples were delivered to ARI Labs where samples were mixed, split using a churn-splitter, and then analyzed for parameters listed in Table 11 of the QAPP.

Approximately six hours after the start of the sampling event, the autosampler for Mesocosm #22 stopped working. This was corrected by replacing the pump head on the autosampler. In total, this autosampler was offline for approximately 45 minutes. This short offline period is not considered to have materially affected the water quality sampling results.

### **3.2 Water Quality Data**

Laboratory analytical results are summarized in Table 2 and full results will be submitted as part of the Final Report. Analytical results for total and dissolved zinc were low in effluent from some of the mesocosms, with a total of six values below detection limits and another two between the detection limit and the reporting limit.

A rinsate blank was collected during water quality event #2 according to the method presented in the QAPP. Analytical results indicated that total copper and nitrate-nitrite were detected at concentrations slightly above respective detection limits but below respective reporting limits. No other water quality parameters were detected in the rinsate blank sample.

**Table 2. Water quality results for TSS and metals**

Location	TSS	Total Kjeldahl Nitrogen	Nitrate-Nitrite	Total Phosphorus	Orthophosphorus	Copper, total	Copper, dissolved	Zinc, total	Zinc, dissolved
Units	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L
Influent Target <sup>1</sup>	120	3 <sup>2</sup>		0.4	NA	40	NA	150	NA
Influent	67	0.8	2.3	0.554	0.326	25	6.13	156	82.2
12: Standard BSM, outlet controlled	42	7.7	2.17	1.14	0.59	26.2	10.1	22.8	3.79 <sup>4</sup>
33: Standard BSM, media controlled	34	3.6	3.45	1.15	0.8	18.4	8.6	19.9	5.12
22: Mature BSM, outlet controlled	2	0.9	2.04	0.067	0.042	7.16	5.57	< 5 <sup>3</sup>	< 5 <sup>3</sup>
13: Mature BSM, media controlled	2	0.7	2.09	0.073	0.048	4.74	4.74	< 5 <sup>3</sup>	< 5 <sup>3</sup>
15: Alternative BSM, outlet controlled	10	0.6	1.14	0.339	0.235	7.57	3.44	4.41 <sup>4</sup>	< 5 <sup>3</sup>
34: Alternative BSM, media controlled	15	0.5	1.57	0.385	0.265	11.2	3.86	5.99	< 5 <sup>3</sup>

<sup>1</sup> Influent target values are from the QAPP for high pollutant.

<sup>2</sup> The QAPP presented an influent target of 3 mg/L for total nitrogen which is the sum of nitrate-nitrite and total Kjeldahl nitrogen.

<sup>3</sup> Values were below the detection limit of 5 µg/L

<sup>4</sup> Values were between the detection limit and the reporting limit.

## 4 Vegetation Monitoring

No vegetation monitoring was completed during Monitoring Period #2. The next vegetation monitoring event will be completed in fall 2021.

## 5 Operations and Maintenance Monitoring

Operations and maintenance (O&M) monitoring consisted of monthly system operation checks including cleaning and level checks for tipping bucket flow meters, inspecting outlet control orifices for clogs, checking base water level in CTD sensor reservoirs, cleaning and inspecting cistern weir boxes, replacing desiccant in data logger boxes, and weather station inspections.